4 PRACTICE AND APPLY

Assignment Guide

Answer Transparencies available for all exercises

Basic:
Day 1: EP p. 1015 Exs. 12–15
pp. 495–498
Exs. 1–8, 15–22, 31–35 odd, 39–44, 55–59, 63–69 odd, 72

Average:
Day 1: pp. 495–498
Exs. 1, 2, 7–11, 15–18, 23–26, 34–36, 39–45, 51–53, 55–61, 64, 68, 70, 73

Advanced:
Day 1: pp. 495–498
Exs. 1, 2, 11–16, 27–30, 36–38, 44–62*, 66, 71, 74

Block:
pp. 495–498
Exs. 1, 2, 7–11, 15–18, 23–26, 34–36, 39–45, 51–53, 55–61, 64, 68, 70, 73 (with 7.4)

Differentiated Instruction

See *Algebra 2 Best Practices Toolkit* for suggestions on addressing the needs of a diverse classroom.

Homework Check

For a quick check of student understanding of key concepts, go over the following exercises:

Basic: 6, 20, 42, 55, 57

Average: 10, 24, 46, 56, 57

Advanced: 14, 28, 48, 56, 58

Extra Practice

- Student Edition, p. 1016
- Chapter 7 Resource Book: Practice levels A, B, C, pp. 30–32

Practice Worksheet

An easily-readable reduced practice page (with answers) for this lesson can be found on p. 476C.

42–50. See Additional Answers beginning on p. AA1.

ERROR ANALYSIS *Describe* and correct the error in simplifying the expression.

17. $(3e^{5x})^2 = 3e^{(5x)(2)}$
$= 3e^{10x}$

The 3 should be raised to the second power also; $(3e^{5x})^2 = 3^2e^{(5x)(2)} = 9e^{10x}$.

18. $\frac{e^{6x}}{e^{-2x}} = e^{6x - 2x}$
$= e^{4x}$

$-2x$ should be subtracted; $e^{6x-(-2x)} = e^{8x}$.

EXAMPLE 2 on p. 492 for Exs. 19–30

EVALUATING EXPRESSIONS Use a calculator to evaluate the expression.

19. e^3 about 20.086
20. $e^{-3/4}$ about 0.472
21. $e^{2.2}$ about 9.025
22. $e^{1/2}$ about 1.649
23. $e^{-2/5}$ about 0.670
24. $e^{4.3}$ about 73.700
25. e^7 about 1096.633
26. e^{-4} about 0.018
27. $2e^{-0.3}$ about 1.482
28. $5e^{2/3}$ about 9.739
29. $-6e^{2.4}$ about -66.139
30. $0.4e^{4.1}$ about 24.136

GROWTH OR DECAY Tell whether the function is an example of *exponential growth* or *exponential decay*.

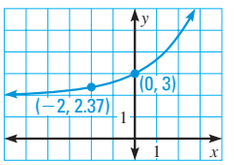
31. $f(x) = 3e^{-x}$ exponential decay
32. $f(x) = \frac{1}{3}e^{4x}$ exponential growth
33. $f(x) = e^{-4x}$ exponential decay
34. $f(x) = \frac{3}{5}e^{x}$ exponential growth
35. $f(x) = \frac{1}{4}e^{-5x}$ exponential decay
36. $f(x) = e^{3x}$ exponential growth
37. $f(x) = 2e^{4x}$ exponential growth
38. $f(x) = 4e^{-2x}$ exponential decay

EXAMPLE 3 B on p. 493 for Exs. 39–50

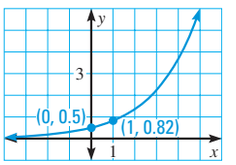
MATCHING GRAPHS Match the function with its graph.

39. $y = 0.5e^{0.5x}$ B
40. $y = 2e^{0.5x}$ C
41. $y = e^{0.5x} + 2$ A

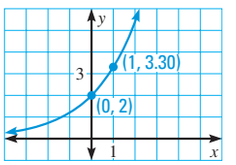
A.



B.



C.



GRAPHING FUNCTIONS Graph the function. State the domain and range. 42–50. See margin.

42. $y = e^{-2x}$
43. $y = 3e^{x}$
44. $y = 0.5e^{x}$
45. $y = 2e^{-3x} - 1$
46. $y = 2.5e^{-0.5x} + 2$
47. $y = 0.6e^{x-2}$
48. $f(x) = \frac{1}{2}e^{x+3} - 2$
49. $g(x) = \frac{4}{3}e^{x-1} + 1$
50. $h(x) = e^{-2(x+1)} - 3$

51. 10,000,000,000. *Sample answer:* Since small values of n were increasing the function very slowly, I checked larger intervals. I noticed that every power of 10 gave an answer one digit closer to the actual value of e.

51. **GRAPHING CALCULATOR** Use the *table* feature of a graphing calculator to find the value of n for which $\left(1 + \frac{1}{n}\right)^n$ gives the value of e correct to 9 decimal places. *Explain* the process you used to find your answer.

52. ★ **SHORT RESPONSE** Can e be expressed as a ratio of two integers? *Explain* your reasoning. No; e is an irrational number which is defined to be a number that cannot be expressed as a ratio of 2 integers.

53. ★ **OPEN-ENDED MATH** Find values of a, b, r, and q such that $f(x) = ae^{rx}$ and $g(x) = be^{qx}$ are exponential *decay* functions and $\frac{f(x)}{g(x)}$ is an exponential *growth* function. *Sample answer:* $f(x) = \frac{1}{2}e^{-3x}$, $g(x) = \frac{2}{3}e^{-5x}$

C 54. **CHALLENGE** *Explain* why $A = P\left(1 + \frac{r}{n}\right)^{nt}$ approximates $A = Pe^{rt}$ as n approaches positive infinity. $\left(\textit{Hint:}\ \text{Let } m = \frac{n}{r}.\right)$ See margin.

○ = WORKED-OUT SOLUTIONS on p. WS1

★ = STANDARDIZED TEST PRACTICE

54. Let $m = \frac{n}{r}$, so $n = mr$ and $\frac{r}{n} = \frac{1}{m}$. Substituting into $A = P\left(1 + \frac{r}{n}\right)^{nt}$ gives $A = P\left(1 + \frac{1}{m}\right)^{mrt}$ which can be written as $A = P\left(\left(1 + \frac{1}{m}\right)^{m}\right)^{rt}$. By definition, $\left(1 + \frac{1}{m}\right)^{m}$ approaches e as m approaches $\pm\infty$. Thus the equation becomes $A = Pe^{rt}$.

PROBLEM SOLVING

EXAMPLE 4 A
on p. 494
for Exs. 55–56

55. CAMERA PHONES The number of camera phones shipped globally can be modeled by the function $y = 1.28e^{1.31x}$ where x is the number of years since 1997 and y is the number of camera phones shipped (in millions). How many camera phones were shipped in 2002? **about 8.95 million camera phones**

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56. BIOLOGY Scientists used traps to study the Formosan subterranean termite population in New Orleans. The mean number y of termites collected annually can be modeled by $y = 738e^{0.345t}$ where t is the number of years since 1989. What was the mean number of termites collected in 1999? **about 23,247 termites**

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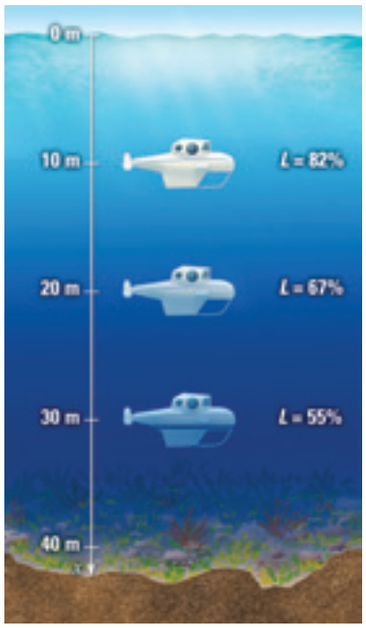
EXAMPLE 5
on p. 495
for Exs. 57–58

57. FINANCE You deposit $2000 in an account that pays 4% annual interest compounded continuously. What is the balance after 5 years? **$2442.81**

58. FINANCE You deposit $800 in an account that pays 2.65% annual interest compounded continuously. What is the balance after 12.5 years? **$1114.17**

B

59. MULTI-STEP PROBLEM The percent L of surface light that filters down through bodies of water can be modeled by the exponential function $L(x) = 100e^{kx}$ where k is a measure of the murkiness of the water and x is the depth below the surface (in meters).



a. A recreational submersible is traveling in clear water with a k-value of about -0.02. Write and graph an equation giving the percent of surface light that filters down through clear water as a function of depth. **$L(x) = 100e^{-0.02x}$, see margin for art.**

b. Use your graph to estimate the percent of surface light available at a depth of 40 meters. **about 61%**

c. Use your graph to estimate how deep the submersible can descend in clear water before only 50% of surface light is available. **about 35 m**

60. ★ EXTENDED RESPONSE The growth of the bacteria *mycobacterium tuberculosis* can be modeled by the function $P(t) = P_0e^{0.116t}$ where $P(t)$ is the population after t hours and P_0 is the population when $t = 0$.

a. Model At 1:00 P.M., there are 30 *mycobacterium tuberculosis* bacteria in a sample. Write a function for the number of bacteria after 1:00 P.M. **$P(t) = 30e^{0.116t}$**

b. Graph Graph the function from part (a). **See margin.**

c. Estimate What is the population at 5:00 P.M.? **about 48 bacteria**

d. Reasoning *Describe* how to find the population at 3:45 P.M. **Let $t = 2.75$ and evaluate $P(2.75)$.**

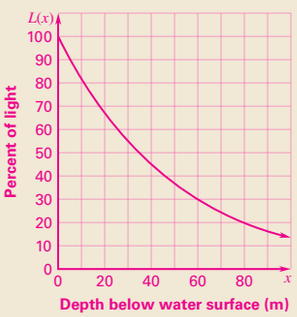
Internet Reference

Exercise 24 For more information about the Gateway Arch, visit the National Park Service's website at www.nps.gov/jeff/arch.html

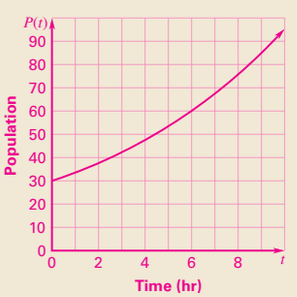
Graphing Calculator

Exercises 42–50 Use a graphing calculator demonstration or guide students in a calculator investigation to help them see both graphically and numerically that the domain of all exponential functions is the set of all real numbers, and that the range is directly related to the equation of the horizontal asymptote. Use the *table* feature to show that the y-values get closer and closer to a fixed value, but never get there, either as x decreases or increases, depending on whether you are looking at an increasing or decreasing function.

59a.



60b.



5 ASSESS AND RETEACH

Daily Homework Quiz

Transparency Available

1. Simplify $(e^x \cdot e^{-3x})^2$. $\frac{1}{e^{4x}}$
2. Use a calculator to evaluate $e^{-0.35}$. (Round to three decimal places.) 0.705
3. State the domain and range of the function $y = 2e^{0.3(x-5)} + 3$. domain: all real numbers; range: $y > 3$
4. You deposit $1200 in an account that pays 4.8% annual interest compounded continuously. What is the balance after 4 years? $1454.00

Online Quiz

Available at **classzone.com**

Diagnosis/Remediation

- Practice A, B, C in Chapter 7 Resource Book, pp. 30–32
- Study Guide in Chapter 7 Resource Book, pp. 33–34
- Practice Workbook, pp. 112–113
- @HomeTutor

Challenge

Additional challenge is available in the Chapter 7 Resource Book, p. 37.

Quiz

An easily-readable reduced copy of the quiz (with answers) on Lessons 7.1–7.3 from the Assessment Book can be found on p. 476E.

Quiz 1–3, 8–11. See Additional Answers beginning on p. AA1.

12.

61. RATE OF HEALING The area of a wound decreases exponentially with time. The area A of a wound after t days can be modeled by $A = A_0 e^{-0.05t}$ where A_0 is the initial wound area. If the initial wound area is 4 square centimeters, what is the area after 14 days? about 1.986 cm^2

C **62. CHALLENGE** The height y (in feet) of the Gateway Arch in St. Louis, Missouri, can be modeled by the function $y = 757.7 - 63.85(e^{x/127.7} + e^{-x/127.7})$ where x is the horizontal distance (in feet) from the center of the arch.

a. Use a graphing calculator to graph the function. How tall is the arch at its highest point? 630 ft

b. About how far apart are the ends of the arch? about 630 ft

MIXED REVIEW

Solve the equation.

63. $|x + 8| = 13$ *(p. 51)* 5, −21

64. $|3x + 17| = 16$ *(p. 51)* $-\frac{1}{3}$, −11

65. $2x^2 - 4x + 9 = 0$ *(p. 292)* $\frac{2 \pm i\sqrt{14}}{2}$

66. $x^2 + 12x - 3 = 0$ *(p. 292)* $-6 \pm \sqrt{39}$

67. $\sqrt{5x + 9} = 7$ *(p. 452)* 8

68. $\sqrt{15x + 34} = x + 6$ *(p. 452)* 1, 2

PREVIEW
Prepare for Lesson 7.4 in Exs. 69–74.

Find the inverse function. *(p. 437)*

69. $f(x) = 2x$ $y = \frac{1}{2}x$

70. $f(x) = 5x - 3$ $y = \frac{1}{5}x + \frac{3}{5}$

71. $f(x) = -4x + 14$ $y = -\frac{1}{4}x + \frac{7}{2}$

72. $f(x) = \frac{1}{3}x + 4$ $y = 3x - 12$

73. $f(x) = -12x - 6$ $y = -\frac{1}{12}x - \frac{1}{2}$

74. $f(x) = -\frac{1}{4}x + 7$ $y = -4x + 28$

QUIZ *for Lessons 7.1–7.3*

Graph the function. State the domain and range. 1–3. See margin for art.

1. $y = 2 \cdot 3^{x-2}$ *(p. 478)* domain: all real numbers, range: $y > 0$

2. $y = \left(\frac{2}{5}\right)^x$ *(p. 486)* domain: all real numbers, range: $y > 0$

3. $f(x) = \left(\frac{3}{8}\right)^x + 2$ *(p. 486)* domain: all real numbers, range: $y > 2$

Simplify the expression. *(p. 492)*

4. $3e^4 \cdot e^3$ $3e^7$

5. $(-5e^{3x})^3$ $-125e^{9x}$

6. $\frac{e^{4x}}{5e}$ $\frac{1}{5}e^{4x-1}$

7. $\frac{8e^{5x}}{6e^{2x}}$ $\frac{4}{3}e^{3x}$

Graph the function. State the domain and range. *(p. 492)* 8–11. See margin.

8. $y = 2e^x$

9. $y = 3e^{-2x}$

10. $y = e^{x+1} - 2$

11. $g(x) = 4e^{-3x} + 1$

12. TV SALES From 1997 to 2001, the number n (in millions) of black-and-white TVs sold in the United States can be modeled by $n = 26.8(0.85)^t$ where t is the number of years since 1997. Identify the decay factor and the percent decrease. Graph the model and state the domain and range. Estimate the number of black-and-white TVs sold in 1999. *(p. 478)* 0.85, 15%; see margin for art, domain: $t \geq 0$, range: $n > 0$; 19,363,000 TVs.

13. FINANCE You deposit $1200 in an account that pays 4.5% annual interest compounded continuously. What is the balance after 5 years? *(p. 492)* $1502.79

EXTRA PRACTICE for Lesson 7.3, p. 1016 **ONLINE QUIZ** at classzone.com

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